Summary Report of the International Advanced Robotics Programme
Joint Coordinating Forum Annual Reports for 2002

Introduction

The purpose of this report is to present a single summary of the various country reports prepared for the IARP Joint Coordinating Forum held in Frascati, Italy in November 2002. The intent is to give a short summary statement of some of the major advanced robotic research activity being carried out around the world.

IARP is an intergovernmental body whose aim is "To foster international cooperation toward the development of advanced robotic systems capable of eliminating or minimizing human exposure to difficult activities in harsh, demanding, dangerous conditions or environments".

The current full member countries of IARP are Austria, Belgium, Brazil, Canada, Peoples Republic of China, France, Germany, Italy, Japan, Korea, Russia, Spain, United Kingdom, and the United States of America. Additionally there are two members with observer status, namely New Zealand and the European Commission.

Overview

The overall position represented in the reports is one of substantial and diverse development activity being carried out around the world in significant research areas. A substantial portion of this research is tackling new areas of robotics such as nano-robotics and mico-robots. However, it is clear that in several of the key IARP focus areas (e.g. medical robotics and humanitarian demining) significant progress is being made both in terms of the amount of research being carried and also in terms of the progress towards usable systems with high social and economic benefit.

Country Summaries

This section presents the summary of each country's report from the perspective of the contributor. As well as the individual country reports, a summary report from the European Commission is also presented, this being in the context of a major sponsor of robotics research within Europe.

For those wishing to read more detail, the full country reports are available on-line at www.eng.nsf.gov/roboticsorg/

AUSTRIA

Awaiting Report

BELGIUM

Robotics activity in Belgium has several foci with leading research centres taking a lead role on specific research topics. Of particular note is the work on Microrobots being undertaken by the Free University of Brussels, Multi-agent Systems at the Katholic University of Leuven, Humanoid Robots at the Vrije University of Brussels and Micro Unmanned Aerial Vehicles together with Multi-legged Robots at the Royal Military Academy. Additionally many universities are pursuing the development of robots for Edutainment, a goal that is supported by the Belgian Robotics and Training Centre (RoboCen).

As with other European countries, Belgium is an active participant in several European projects and networks. The projects include the Open Robot Control (OROCOS) project, the Airborne Minefield Area Reduction Project (ARC), The Space and airborne Mined Area Reduction Project (SMART) and the DEMINE project, which is aimed at the development of a cost-efficient surface penetrating radar detector.

With regard to European networks, Belgium is an active partner in several networks including CLAWAR (Climbing and walking robots), EURON (European robot network), EUDEM (European Demining) and EURO-UVS(The European Unmanned Vehicle Systems Association).

Belgium is also taking one of the lead roles in Humanitarian Demining activities, both within IARP and within the European Union projects. This has included the organisation of a major demining conference at RMA Belgium and assisting with the organisation of a similar event at TU Vienna. Belgium has also launched Expressions of Interest for a new Network of Excellence for Mine Action Technologies under the European Framework 6 and for an integrated project in Hudem under FW 6 (2.6)

BRAZIL

Robotics research in Brazil is steadily growing and spreading throughout the major universities and research centres in the country. An important account of the activities in Industrial Automation, and Robotics in particular, is presented in a recently edited book (in Portuguese) which was prepared by participants of the research network MANET (Manufacturing Automation NETwork). The network is one of the four sub-networks that form the Industrial Automation Network and deals with topics related to manufacturing industry and robotics. This kind of network (which has the acronym RECOPE) were supported by one major research funding agency, FINEP which is linked to the Brazilian Ministry of Science and Technology. Some of the main recent robotic projects in non-industrial environments are related to underwater robotics (usually supported by the Petroleum National Agency funds and Petrobras - the National Oil Company), piping inspection and cleaning, underwater robots for inspection of hydro-electric power plants, robots for large turbine inspection and repair (also in power plants), mobile robots (legged and wheeled), devices for TV camera motion (sport events and Carnival Shows), aerial "zeppelin" robots for inspection (environment and city security), robots to install signaling balls in electrical transmission lines (to avoid collisions with aerial vehicles), domotics (applied Information and Communication Technologies in and around the Home), and web-

robots. Virtual reality and haptics are also starting to be developed in some centres. One application is in medical robotics (telesurgery). Another major application is in the design and repair of underwater sites for the offshore industry.

An overview of the research activities being developed in Brazil in the area of Robotics has been carried out. The data were collected from reports requested from several research groups that were already in our past mailing lists as well as from new groups which have presented papers in the robotics field in the national conferences. We have not noticed a substantial change in the activities of older groups but have noticed an increase in the number papers related with robotics in the national conferences such as the Brazilian Conference on Automation *(Congresso Brasileiro de Automática, September 2002, Natal).*

CANADA

Despite its geographical vastness and the dispersion of its population in some areas, Canada wants to maintain universality of access to health care services to its entire population. To reduce the ever-escalating costs of healthcare, several organizations are currently investing in telemedicine facilities and in technologies to enable the remote diagnosis (and treatment) of patients. So far, most efforts have been oriented towards tele-diagnosis but robotic technologies are now being developed for robotically assisted surgery or telesurgery.

Another important area for the commercialization of robotic technologies will be agriculture. Environmental considerations are pushing to reduce the spraying of herbicides and pesticides at large. Legislation will soon ban such practices. This will force the transformation of the agriculture industry towards precision-agriculture, which is labour-intensive. However, Canada is facing severe competition from other nations: some nations with lower wages fare better over the global market because of lower production costs and the USA are currently considering whether to subsidise agriculture at levels even higher than the current ones. Robotic technologies could potentially enable precision agriculture at a reasonable cost.

PEOPLES REPUBLIC OF CHINA

With the support of the Chinese National High-Tech R&D Programme, some innovative achievements of advanced robotics (such as humanoid robots, bionics robots, mobile robots, medical robots, pipe robots, network-based robots, micro-manipulation systems and service robots) have been obtained in the past year. A brief overview of these is given below:

Wall-climbing robots. The HIT has successfully developed two series and five types of wall-climbing robots, which are based on negative pressure attraction and magnetic attraction, respectively. At present, the main use of wall-climbing robotics techniques is in construction cleaning, such as the glass ceiling for the Beijing railway west-station. In this kind of practical use, the wall-cleaning robots made by the HIT and BUAA are being put into the market.

Humanoid robots. A new type of Humanoid robot has been developed in BIT. The BHR-01 humanoid consists of a head, two arms and two legs, and has total 31 DOF.

The head of contains 3 DOF, each leg consists of a thigh, shank and foot and has a total of 6 DOF, and each arm consists of an upper arm, forearm and hand, and has a total of 8 DOF. The computer system and power supply are integrated in humanoid body. The height is 1.6m and the weight is about 76.0kg.

Robot-assisted medical mechatronics. More and more effort is being spent on R&D associated with medical robots by most Chinese universities and academic institutions. Among them, frameless stereotactic neurosurgery system has been a great success. Discarding the cumbersome frame, the robot-assisted frameless stereotactic neurosurgery system uses markers for registration. It simplifies the operation procedure, increases operation efficiency and safety, and shortens recovery time for the patient. So far it has been used for practical neurosurgery in more than 50 cases.

Micro-manipulating robots. A new type of biologic-medical experimental robot has been developed in Nankai University. The operator can control the motion of micromanipulator & micro-holder by computer. By means of the micro-vision & image processing, the actions of micro-tools on biological bodies can be performed with high precision automatically. The system can be applied to some micromanipulations of biological bodies, such as trans-gene through microinjection to cells, to micro-cutting experiments of the chromosome. Meanwhile, a tele-micromanipulating robot system based on microassembly has been successfully developed at HIT and will be applied to micro-assembly of micro parts and MEMS parts.

Mobile robots. Most recently, a new type of mobile robot was developed in the Institute of Automation, Chinese Academy of Sciences. It is characterized by with higher intelligence for convenient use in offices, families, hospitals, libraries and exhibitions. It can hear and understand the operator oral Chinese commands from a wireless microphone, and then it will respond to the Chinese-based commands with both Chinese-based speech system and locomotion system.

FRANCE

The 2002 report briefly mentions the continued overall multi-institutional activity encompassing a broad spectrum of Robotics domains successively highlighted in past reports. A special note is first made of Medical Robotics, one of the major fields considered by IARP, which is certainly one of the fastest growing research efforts in France. The report is focussed in the contents of two sections, outlined below. (for reports from 99 to 02 see http://www.laas.fr/iarp-france/)

Within the framework of Human Centred Robotics France is actively promoting the domain of Assistive and Personal Robotics that, both by its technical aspects and societal and economical impacts, opens a true Grand Challenge. Here are brought up frontline research themes ranging from learning to multi-modal HMI, with special attention devoted to the central aspect of Robot Dependability in Human Environments (see http://www.laas.fr/drhe02/preprints.pdf).

The *Robea* program, launched by CNRS in 2001, addresses robotics as the interdisciplinary study, design and integration of sensory-motor and cognitive functions thus covering from the main disciplines in Information Sciences and Technologies to Neuroscience, Humanities and Social Sciences, Cognitive Sciences, and Medical Sciences. The program supports collaborative research projects from academic laboratories in France, affiliated to CNRS, to Universities and other public research institutions such as INRIA, ONERA, CEA, INSERM or IFREMER. It is open to collaborations with the industry and with foreign partners (see http://laas.fr/robea/)

GERMANY

The 2002 report summarizes the main multi-institutional activities in the field of robotics research. Highlights of German activity in this area are given below:

In 2002 about 12,800 Industrial Robots were installed in Germany. About 106,000 are estimated as being in the operational stock at 2002 year-end.

There are several large projects which focus on human centred robot systems, mainly for service, personal assistance and human health care.

The MORPHA project (research and industry) is developing basic technologies for manufacturing and personal assistance systems.
Several Collaborative Research Centres with a time horizon of up to 10 –12 years have been established by the German Research Agency (DFG) and address basic research in the field of:
Telepresence Systems (Munich)
Design and Control of Redundant Robots (Braunschweig)
Humanoid Robots (Karlsruhe)
Space Cognition (Bremen)
Robots in Surgery (Karlsruhe)
Furthermore there are research networks sponsored by the DFG which are related to:
Mobile Multiagent Systems (Robocup and Rescue)
Dynamic Walking Machines (Biologic motivated systems)

Applied research in the field of industrial robotics is still of strategic importance. There are several programs promoting new applications and products for SMEs (developers, vendors and users)

A new robot society was founded in 2001 which is called Deutsche Gesellschaft für Robotik -DGR- (in english: German Society for Robotics). This society is composed of the following German Research and Engineering Societies which are active in the field of robotics: VDI/VDE, GMA, ITG, GI, IEEE Robotics & Automation, German Branch, ECCAI, CURAC, German Chapter of the European Neural Society, DAGM, Fraunhofer Gesellschaft. The purpose is to sponsor activities in the field of robotics research, education, engineering and applications in the spirit of a constructive

cooperation. DGR is organizing an overall German Robotics Conference every 2 years, which is also open to researchers from other countries.

The 1st conference took place in Berlin in June, 2000, the 2nd took place in Ludwigsburg in June, 2002 and the 3rd will take place in Munich in June, 2003.

ITALY

Italy is involved in several major research projects involving the development and application of advanced robotics. Four key projects and their main Italian participants are highlighted below:

Robots for Antarctica environment (RAS, SARA, RUISS, SAITES) - ENEA, CNR, Un. of Genova, Parma, Perugia, Pavia, Tecnomare srl, Idromar.
Space Robotics activity - ASI and space qualified industries (Tecnospazio srl, Tecnomare srl, Carlo Gavazzi, Alenia Spazio, Officine Galileo)
Parallel supercomputing applied to robotics (PRASSI, SIRO, SENSI) - about 30 partners among these ENEA, CNR, Dappolonia, INTECS, NERGAL.
Participation to a number of international research programs including CLAWAR (Climbing and walking robots) and the European Robots Excellence Network EURON.

As in many other European countries the funding for robotics is tending to be driven by the application rather than the technology. It is also notable that there is currently a lack of long term investment in this area from industry together with a fragmentation of the research teams undertaking publicly funded research. To address this situation, new public research investment is aimed at promoting the fusion of research groups, both within and between research institutions, and to substantially enhance the cooperation between industry and publicly funded research.

JAPAN

Though Japanese economy has not been in good condition since the beginning of 1990s, the amount of the industrial robot production in 2000 was 660 billion JPY which a record for the Japanese robot industry. This was primarily due to an increase in the number of exported industrial robots. However, in 2001, this figure fell to about 400 billion JPY due to a slow down in the export business. In order to adapt the production demands to smaller numbers of various kinds of products there has been a tendency toward the introduction of human workers together with automated machines in manufacturing factories over the last 10 years. This tendency continues and is causing the number of newly used robots Japan to reduce as well as reinforcing the bad economic conditions. To expand the robotic industry activity, new robotic market products are expected to be found. Human friendly robots, which mean the robot which can provide services to human in human environment in daily life, are considered as one of the candidates. There are industrial R&D activities concerning robotic home electronic products like the vacuum cleaner robot, entertainment robot, home security

robot, rehabilitative robot, and information service home robot. In 2001, the meal service robot for handicapped was supplied to the commercial market by a Japanese company.

To encourage non-industrial applications of robot, several analyses of the robotic industry have been carried out. One of such reports distinguishes two types of robotic products. The first is the ready-made product which is sold as a catalogue product like an industrial robot. The other is the custom-made product which is developed and sold according to the order from a customer, such as a space arm, airplane cleaning robot, underwater inspection robot and so on. The custom-made business in robotics is now recognized as being very important in order to expand the robotic business in future due to the growing personalization needs of users. With this in mind, a new 3 year METI's national project to develop middleware which can standardize various robotic components available in the market and make the system integration using them easy was started in October 2002.

With regard to humanoid technology, Honda and Sony continue R&D for application to entertainment and guide service robot. METI's national project, the Humanoid Robot Project (HRP) which started in 1998, is under way at AIST and several participating industries. In 2002, Kawada/AIST developed new humanoid platform which is called HRP-2. It has an open-architecture with a compact body that includes a battery. Also, several humanoid application preliminary experiments are carried out to develop some practical application areas and their relating humanoid business using a developed humanoid platform in the project. At the end of March 2003, the project will be finished. Currently, several demonstrations which show the final results of the project are planned.

Some new trend in robotics in Japan which could be seen in 2001 is that the Government instigated research on humanitarian demining robotics and rescue robotics. The Ministry of Education, Culture, Sports, Science and Technology has started humanitarian demining robotics projects (with the solving of Afghanistan problems in mind) and a new program for rescue robotics based on Kobe earthquake experiences. The Ministry of Economy, Trade and Industry (METI) also started a new project for humanitarian demining robotics to solve the Afghanistan problems.

Robotics R&D in academia is still very active as reported in last year's report. The number of robotics papers given at conferences for domestic robots is also increasing this year. The attention of the researchers in robotics fields is centred on the humanoid robot and human-robot co-existence technology. This phenomena still continues. The Robotics Society of Japan and the Japan Robot Association (JARA) were 20 and 30 years old, respectively. A memorial event was carried out by each organization.

REPUBLIC OF KOREA

Korea has been recognized for its high installation and high density of industrial robots in world terms. However, as a result of the economic crisis that hit Korea in 1998, the installation rate of manufacturing facilities has sharply decreased which in turn has led to a decrease of demand of industrial robots. The role of the large-sized robot supply industries has been reduced to the point that their services have become limited only to their internal needs in 2002.

In Korea, some 50 companies are engaged in robot businesses and they are mainly small and medium sized industries. Their activities in the non-industrial robot field were prominent in 2002 as they introduced commercial grade robot products to the market. Major products are in the area of personal robot for information management and secretarial service, education and entertainment robots for on-line education, robot games and toys, as well as research and education robots for robot education kits and research platforms.

A Personal Robot base technology development programme has been initiated by the Ministry of Commerce, Industry and Energy (MOCIE) to develop and to promote the base technology of the personal robot in the robotic industries in order to prepare for the emerging advanced robotics market in the 21st century. This programme includes robots for game and entertainment as well as highly sophisticated domestic and education robots. The project has a planned 10-year span and its budget for the first year is some 2,700,000 US Dollars.

In 2002, significant outcomes arose from government supported research projects. They included two field models of tele-operated robots for removing dangerous objects (which originated from a dual use robotics technology research program) and the nursing robot, the walk-helping robot, the bedside robot as well as the bone mountable ARTHROBOT from the Human-friendly Welfare Robot system-Engineering Research Center (HWRSERC)

The year 2002 has been characterized by its abundance of robot exhibitions and robot games. The most significant robot events have been the international robot football game by the Federation of International Robot-soccer Association (FIRA) in May and the International Intelligent Robot Exhibition (JIREX 2002) in June, prior to the world cup football game taken places in Korea.

RUSSIA

The 2002 report briefly reflects new theoretical and experimental results of R&D obtained this year in the area of advanced robotics previously started and that have been partially mentioned in previous reports. The main scientific efforts concentrated on Mobile robots, Medical robots and Microrobotics based on MEMS technology which have traditional interest and supported by sponsor organizations - The Russia Academy of Sciences (RAS), The Russia Foundation for Basic Researches (RFBR), The Ministry of Industry, Science and Technologies (MINPROMNAUKA) and The Ministry of Education (ME).

Progress has been made in such areas of advanced robotics as the locomotion and climbing of flexible multi-link robot over irregular surfaces, path planning based upon robot vision and perception of 3D space in a non-determined or dynamically changing environment, micro sensory fusion, human-robot interface, computer software, architectures for autonomy, artificial intelligent control to realize decision making procedures for motion in hazardous environments, fuzzy logic, and neural network systems.

New design solutions were realized for the machines working in swamps, in-pipe inspection robots, mobile rescue robots, medical robots for massage and mobilization, wall climbing machines for fire-fighting purposes, and teleoperated robots. The R&D for these special

mobile robots are produced in MSTU (Bauman), IPM RAS, KIAM, VSTU (Volgograde), USTU (Ufa), SpSTU (Sankt-Petersburg).

The programme for students and young scientist's education evolved at the Mobile Robots Festival in Moscow (organized by MSU, KIAM and MPEI) and the Conference and Scientific School on the topic of Intelligent Robots in Katsively, Crimea, under the supervision of Taganrog Radiotechnic University. They were conducted in the frame of Russian Federal Program on "Integration of Sciences and High Level Education in Russia", covering the years 2002 – 2006. The coordinated projects of RAS, RFBR, MINPROMNAUKA, ME consider robotics as a multi-profile study related with modern technologies such as not only machinery, industry or production, but also nano- and bio-technologies, and information, medical, social, and humanity aspects.

The projects combine together the researchers from Academic laboratories belonging to RAS (IPM, KIAM, IMASH) with Universities, R&D Centres and users, including industry.

These projects are open for cooperation with foreign partners on basic and applied research into robotics and it applications. The existing international cooperation will be realized as with previous collaborative projects such as EUREKA, INTAS, CARRA and other bilateral agreements. This report is coordinated every year with the Report of the Scientific Council on Robotics and Automation of the Russian Academy of Sciences and the Ministry of Education of the Russian Federation.

SPAIN

Spain joined to the worlds' robot community at the very start of this technology, and Spanish scientific contribution to the field can be traced back to the early seventies. The development of robots and its industrial dissemination during the 80s' prepared the way for fundamental research. Not only industrial applications, but also interesting developments of robots for hostile/hazardous environments, like nuclear power plants, were undertaken. During the 90s' for the very few groups pioneering the robotics activities in the previous years there followed an explosion of new groups, sometimes of high competence, that conducted numerous research projects with significant success. The economic growth of Spain played a major role in this respect, and the increased public funding, along with the new funding opportunities coming from participation in EC projects, provided a framework for sustainable development of the robotic activities. Currently, new and sophisticated contributions both in fundamental aspects and in new application sectors are being performed. It can be said, observing the Spanish participation in European projects (see CORDIS database: http://www.cordis.lu) that both Robotics Research Institutions and Industries in Spain are undoubtedly at European level.

A very effective framework for the dissemination of robotic activities in Spain and for the preparation of a sound basis for enabling the participation of Spanish research groups within multinational projects has been set up by the incorporation of several groups within international networks. The active groups not only belong to Universities or to National Research Organisations, but also there are many companies (including SMEs) that are

participating actively. The international networking activities are deployed in two main geographical areas: European Union and Latin America.

The Ministry of Science and Technology provides funding for, among others, robotics research, throughout the "Plan Nacional de Investigación" (National Research Programme). Presently most of the projects dealing with robotics are funded under the "new umbrella" of DPI ("Design and Industrial Production"). Normally basic research (long-term) projects are of three years duration, while those other projects carried out jointly by Universities/Research Institutes with companies are to be completed within two years. An increasing number of industry oriented projects have been funded in the last three years.

The CDTI, an Institution aimed at providing support to innovation for those Spanish firms willing to invest in innovation and technology, is in charge of promoting the participation in EUREKA (and IBEROEKA), and also has an important co-ordinating role for the participation in EC funded projects. The CYTED Programme is in charge of promoting the co-operation of Spain, Portugal and Latin America Institutions in research/networking projects.

The different Autonomous Communities (AC) provides an additional (very important) source of funding for research, although this funding varies from one AC to another. They funded both basic research and industrially oriented projects.

UNITED KINGDOM

Advanced robotics research in the UK is not carried out under any single coordinated programme. Nevertheless, advanced robotics is once again a growing research area in the UK. This growth is across the board and not just in near-term application areas, such as defence, but also in near to medium term applications such as medical and food robotics and in longer term research areas such as Biomimetics and Haptics.

The problem of a lack of a central coordination programme is being tackled through a number of coordination initiatives and the emergence of Centres of Excellence for given advanced robotic application areas such as Medical Robotics (Imperial College), Subsea Robotics (Herriot Watt University), Walking Robots (Leeds University) and Food Assembly Automation (Salford University).

European funding continues to form an important part of the advanced robotics research funding in the UK. Important projects include Robovolc (a volcano exploration robot), FutureHome (applying advanced manufacturing technology to housing production), ALIVE (a light autonomous underwater inspection robot) and HYDRA (applying the principles of biological self-organisation to micro and nano-scale robots).

Work continues on the Beagle II Mars lander mission which is to be launched on the ESA Mars Express during 2003. If successful this will generate even more public interest, this already being fuelled by popular television programmes.

UNITED STATES OF AMERICA

Robotics research in the US continues on a broad front, from microrobotics to large-scale robotics systems for industry, medicine and other applications. Of special importance in the last year is the enhanced profile of robotics for search and rescue purposes. This focus was stimulated by the tragic events of September 11 in New York, Washington and Pennsylvania. Robots were used extensively in the search for victims at the World Trade Center in New York. Professor Robin Murphy of the University of South Florida (USF) used her robots extensively to search for victims. This increased interest in search and rescue robots provided incentive for a related workshop scheduled to take place at USF in February 2003. Another area of increased interest is sensors technology. The US is interested in improving its ability to sense the potential for biological and chemical warfare as a part of its homeland defence activity. The National Science Foundation has initiated a new initiative in sensing technology and design in 2002. Research outcomes will have profound effects on robotics technology.

Medical robotics research continues apace. The work is conducted at a wide array of academic and industry institutions. Primary among these is the work being done at The Center for Computer-Integrated Surgical Systems and Technology Engineering Research (CISST) Engineering Research Center (ERC) at the Johns Hopkins University, and its partner institutions. The Johns Hopkins Homewood and Medical Institutions, Massachusetts Institute of Technology with Brigham and Women's Hospital, and Carnegie Mellon University with Shadyside Hospital are teamed to develop novel computing methods, interfacial technologies and computer-integrated surgical systems to significantly improve surgical procedures in the 21st century. The Center's industrial affiliations augment the collaboration by providing systems development infrastructure for rapid prototyping and validation of surgical systems concepts. Together, CISST ERC partnerships address a vital national need to greatly reduce surgical costs, improve clinical outcomes, and improve the efficiency of health care delivery. The Center's administrative offices are located on The Johns Hopkins University in Baltimore, together with the computer integrated surgical systems and technology research laboratories. The Center for Medical Robotics and Computer Assisted Surgery (MRCAS) at Carnegie Mellon University has three primary goals to support robotics and computer assisted techniques in medicine, to promote collaboration between physicians and researchers with the Robotics Institute, and to perform application-oriented research aimed at current clinical needs within the medical system. Clinical applications occur at the Center for Orthopedic Research, at Shadyside Hospital. The Massachusetts Institute of Technology's Artificial Intelligence Laboratory (AIL) facilities are used for developing segmentation, registration and tracking algorithms to enhance medical image analysis. The ERC focuses on two inter-related classes of systems, surgical CAD/CAM systems and surgical assistant systems. The first transforms preoperative images and other information into models of individual patients, assists clinicians in developing an optimized interventional plan, registers these preoperative data to the actual patient in the operating room, and then uses a variety of appropriate means, such as robots and image overlay displays, to assist in the accurate execution of the planned interventions. The Surgical assistant systems work interactively with surgeons to extend human capabilities in carrying out a variety of surgical tasks with an emphasis on intraoperative decision support and skill enhancement, rather than preoperative planning for accurate execution.

NEW ZEALAND

An increased interest in advanced robotics in New Zealand has emerged over the last two years and is evident by the activities in tertiary education as well as in industry.

With the founding of a new robotics research centre, there are now five active centres providing robotics research in New Zealand. Four of these centres are located within University departments and one within a crown research institute, Industrial Research. All University departments are offering courses in mechatronics and robotics. The focus of robotics activity in these centres range from HMI issues and robotic programming environments to applications in smart house technology including domestic robots for vacuuming, mowing and security to outdoor robotic platforms for use in farming terrain and underwater.

For the first time, the Australasian Conference on Robotics and Automation *(ACRA)* was held in Auckland, where the above topics from NZ and other topics from Australia were presented. The Robotics NZ consortium continues to provide a good vehicle for the exchange of ideas in coordinating education, research and commercial activities in New Zealand.

Commercial aspects were further developed by IRL in the area of meat automation for sheep and beef processing with renewed export potential to Australia. A local integrator is developing a commercial robotic lamb deboning process in the South Island using German KUKA technology. Local robot manufacturers were very successful with new robot configurations in high speed handling applications. One advanced application involves a flexible, high-speed handling robot for laboratory test tube handling in milk production, one of New Zealand's prime industries. Another example is in the area of large scale palletising with custom-built, cantilevered configurations for multi-lane production in the beverage industry. This application has a high export ratio to Australia.

EUROPEAN COMMISSION

HIGHLIGHTS
Robotics R&D in the IST EU Programme for RTD

Information Society Technologies (IST[1]) is the EU programme for RTD in the field of information and communication technologies, applications and services. During the period 1999-2002, IST has been financing some 50 R&D projects dealing with robotics technologies, with a total EU funding of ~85 million Euro and a total budget of ~133 million Euro. These projects substantially contribute to strengthening the scientific know-how and the technological and industrial basis of Europe in Robotics: they forge multi-partner links and collaborations between academia and industrialists and encourage industry to innovate and, ultimately, to become more competitive.

IST-funded robotics projects are developing both generic technologies (e.g., man machine interfaces, multisensory perception and navigation systems, real time embedded system

[1] The **IST Programme** has a total budget of 3.6 billion Euro for the period 1999-2002. IST is part of the 5th EU Framework Programme (FP5) for Research, Technological Development and Demonstration. For more information about IST, see http://www.cordis.lu/ist

platforms, advanced control methods, micro and nano-robotics, etc.) and advanced prototypes in field-applications (e.g., for risk management, health monitoring, humanitarian demining, serving as tourism guides, as aids for persons with special needs, etc.). Specific calls for proposals have also been launched for initiating high risk long term research projects in topics such as neuroinformatics and life-like perception systems.

Relevant complementary R&D projects in robotics technologies are also being financed by the GROWTH EU Programme[1]: over the period 1999-2002, 20 R&D projects have been funded with a total EU contribution of ~33 million Euro and a total budget of ~59 million Euro.

The 6th EU Framework Programme (FP6) for RTD has been recently adopted for the period 2003-2006 with a budget of 17.5 billion Euro[2]. *Information Society Technologies*[3] and *Nanotechnologies, intelligent materials and new production processes*[4] are two of the priority thematic areas of FP6, which will support, among others, R&D in Robotics. For example, for the year 2003, IST will support –among others– project proposals in robotics focussing in one of the following thematic areas:

Beyond Robotics initiative[5]: Development of Cognitive Robots (robot *assistants or companions to humans*), hybrid bionic systems or autonomous microrobot groups (*robot ecologies*);
Development of Cognitive Systems (physically instantiated or embodied systems that can perceive, understand and interact with their environment, and evolve in order to achieve human-like performance in activities requiring context-specific knowledge).

The GROWTH (*Competitive and Sustainable Growth*) **Programme** has a total budget of 2.7 billion Euro for the period 1999-2002. GROWTH is also part of FP5. For more information about GROWTH, see http://www.cordis.lu/growth.
For more information about the 6th EU Framework Programme, see: http://europa.eu.int/comm/research/fp6/index_en.html.
IST in FP6, see http://www.cordis.lu/ist/fp6/fp6.htm
For more information see http://www.cordis.lu/fp6/nmp.htmc
For more information about this initiative, see http://www.cordis.lu/ist/fetro.htm